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The Zagros Mousterian in the Zagros, Caucasus, and Armenian Highlands

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The great technological and typological variability identified among the Middle Palaeolithic (MP) assemblages previously assigned to the Zagros Mousterian in the Zagros suggests that this industry is not a homogeneous cultural unit. The archaeological record from the Caucasus and Armenian highlands contributes important data to understand the variability of the Zagros Mousterian. The authors show that the long stratigraphic sequences of the caves of Taglar in the Lesser Caucasus and Yerevan-1 in the Armenian highlands provide a line of development (the 'Yerevan–Taglar tradition') of the Zagros Mousterian variant in this region at least from 60/55 to 40 kya. The earliest manifestations of the Zagros Mousterian in the regions may be dated to the early MIS 5 or earlier. The MP assemblages from the cave of Saradj-Chuko and two other MP sites in the Terek river basin represent the northern Caucasian variant of the Zagros Mousterian, which existed in the region from MIS 5 to MIS 3. The remains of Neanderthals associated with the Zagros Mousterian assemblages in the Zagros and Caucasus clearly indicate that the makers of this cultural tradition were Neanderthals.

Keywords: Caucasus, Armenian highlands, Zagros, Middle Palaeolithic, Zagros Mousterian, Neanderthals

Introduction

Different cultural, functional, and chronological interpretations have been proposed for the Middle Palaeolithic (MP) cultures defined in Europe by Bordes (1961a), such as the Ferrassie Mousterian, Quina Mousterian, Typical Mousterian, Denticulate Mousterian, and Mousterian of Acheulean Tradition (MTA), and for the MP technological variants defined later by various scholars, such as Levallois, including laminar (blade), discoidal, Quina, and bifacial technologies (Monnier & Missal, 2014). The Micoquian (termed also the Eastern Micoquian or *Keilmesser* group, KMG) is the most widespread and longest-lasting technocomplex produced by Neanderthals in Europe and spread as far as the Altai in the east (Kolobova et al., 2020) and the Caucasus in the south (Golovanova, 2015).

In this article, we offer a synthesis of data on the Zagros Mousterian. It was defined a meaningful archaeological unit by Skinner (1965) and, since that time, has been part of discussions related to cultural diversity of Neanderthals in Western Asia. The Caucasian archaeological record contributes important data to our understanding of the Zagros Mousterian and its so far undervalued significance for the evolution of archaic humans. Our study is based on

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published data. The lithic assemblages analysed come from both old and recent excavations, and this has affected the assemblage composition (Supplementary Material Table S1). For comparison between the MP assemblages in the Zagros and Caucasus, we employ the typological and technological indices developed by Bordes (1961b; Tables 1 and 2), because most MP sites in the regions were characterized by various researchers using Bordes' method.

The Zagros Mousterian in the Zagros

Definition

The initial definition of the Zagros Mousterian originates in research of the MP assemblages that were recovered in several cave sites in the Zagros, i.e. the mountain ridge extending over 1600 km from the eastern Taurus and Armenian highlands in Turkey in the north-west to the Persian Gulf in Iran in the south-east, and reaching an altitude of 4400 m asl. Dorothy Garrod excavated the first MP site in the Zagros in 1928: Hazar Merd cave in Iraq. Garrod and Bate (1937) defined the most salient features of the assemblage, characterized by a high proportion of narrow blades and tools made on blades, especially points and side-scrapers.

Skinner (1965), using Bordes' (1961b) method, identified all MP assemblages known from caves in the Zagros (layer D at Shanidar and layer C at Hazar Merd in Iraq, and the caves of Bisitun and Kunji in Iran) as a specific Mousterian industry (his 'Group A') and introduced the term 'Zagros Mousterian' to define this industry. He listed a set of techno-typological characteristics, such as a high proportion of narrow blades and tools made on blades, especially elongated retouched points and side-scrapers, an absence of Levallois technique, a high proportion of blanks with faceted platforms, the use of the discoid technique, moderate proportions of tools with Quina retouch, a low proportion of denticulated and Upper Palaeolithic tools, and an absence of bifacial tools, as specific features of the Zagros Mousterian (Table 1). By that time, the discovery of Neanderthal fossils in Shanidar cave (Solecki, 1963) showed that the Zagros Mousterian was produced by Neanderthals.

Akazawa (1975) examined a different sample of artefacts from layer D at Shanidar. He confirmed that the assemblage shared previously defined characteristics of the Zagros Mousterian: a predominance (more than half) of points and side-scrapers, a low percentage of Upper Palaeolithic tool types, and denticulated and Levallois tools.

Since then, and using Bordes' (1961b) method, greater technological and typological heterogeneity has been identified among the MP assemblages in the Zagros. Bewley (1984) showed that the MP assemblage from the Houmian rockshelter in Iran indicated a higher range of variability in the percentage of Levallois tools (ILty), faceting platforms, and side-scrapers than previously thought typical for the Zagros Mousterian. Based on the reduction sequence approach proposed by Frison (1968), now called allometry or the allometric approach (Knell, 2022), Dibble (1984) re-analysed the Bisitun assemblage. He suggested that the main tool types in the assemblage, such as single and double side-scraper and convergent scrapers and points, represent a continuum of reduction of the tools through resharpening. Baumler and Speth (1993) restudied the assemblage from Kunji and confirmed Skinner's (1965) definition.

Dibble and Holdaway (1993) summarized the then available data for MP assemblages in the Zagros and summed up the definition of features typical of the Zagros Mousterian (Table 1). They confirmed that the Zagros MP assemblages are distinct from those in the Levant and from the

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Table 1. *Technological and typological indices defined for the Zagros Mousterian assemblages in the Zagros. For definition of the indices, see Debénath & Dibble (1994).*

	Indices								No. of pieces analysed
Assemblages	**Ilam**	**IL**	**IF/IFs/**	**IQ**	**ILty**	**IR**	**Mousterian Group II**	**Upper Palaeolithic Group III**	
Bisitun	55.1 (35.0)	55.8 (4.8)	64.7 (53.0)	19.5 (6.0)	10.6 (2.4)	68.3 (66.2)	73.3	6.6	724
Warwasi, unit D		11.2		3.7	4.4	53.8	58.9	10.1	158
Warwasi, unit C	38.0	7.5	45.9/30.8/	1.2	9.3	57.4	62.6	8.3	289
Warwasi, unit B	45.3	7.4	53.8/39.6/	6.2	15.6	62.2	67.3	5.3	339
Warwasi, unit A	43.2	13.1	50.2/40.6/	6.5	20.9	56.0	59.2	6.3	191
Kunji	20.8	10.1 (4.5)	48.3	8.6 (5.6)	8.6 (1.5)	62.1 (61.1)	69.9	4.7	268
Houmian, layer 2a	22.9	2.3	23.7	0	11.0 (10.9)	34.2 (33.9)	43.2	7.1	156
Hazar Merd	20.3	7.0	47.1	7.8	1.6 (2.1)	53.3 (53.2)	92.6	3.3	122
Qaleh Kurd, phase 1	15.8	8.2	33.9/33.9/		4.4	59.1	74.2	10.8	230
Qaleh Kurd, phase 2	12.6	7.4	30.4/29.2/		1.7	51.7	71.7	5.1	255
Qaleh Kurd, phase 3	12.3	10.5	28.6/27.1/		6.2	55.6	77.1	5.0	398
Shanidar, D (Skinner, 1965)	12.7	3.0	43.2	4.9	1.1 (1.8)	59.2 (59.0)	79.4	8.6	571
Shanidar, D (Akazawa, 1975)					0.8 (0.7)	24.7	38.9 (36.7)	19.4 (14.6)	714
Mar Tarik	8.6			1.2		29.6	34.7	5.7	360

Notes: Indices for Warwasi after Dibble & Holdaway (1993, tab. 2.2); indices for Houmian, Shanidar D, Kunji, Hazar Merd, and Bisitun after Dibble & Holdaway (1993, tab. 2.9), recomputed by Dibble & Holdaway (1993) on the basis of published type counts (after Skinner, 1965; Akazawa, 1975; Bewley, 1984), but some differ markedly from published indices (in parentheses). Indices for Mar Tarik and Qaleh Kurd were recomputed by the authors on the basis of published type counts (after Jaubert et al., 2009; Kamrani et al., 2022).

Table 2. *Technological and typological indices defined for the Zagros Mousterian assemblages in the Lesser Caucasus and Armenian highlands (after Yeritsyan, 1970, 1975; Jafarov, 1983, 1999).*

Assemblages	Ilam	IL	IF/IFs/	ILty	IR	No. of pieces analysed
Taglar, layer 2	36.0	51.0	69.9/27.5/	av. 37.5	av. 40.3	1214
Taglar, layer 3	33.1	51.3	73.1/29.7/			1140
Taglar, layer 4a	43.7	53.1	73.6/34.4/			667
Taglar, layer 4b	39.0	52.1	62.8/31.4/			396
Dashsalakhly, MP layer	41.6	48.1	71.5/43.0/	22.0	high	326
Taglar, layer 5	25.3	av. 38.4	57.5/22.7/	av. high	av. 55.0	159
Taglar, layer 6	30.7		60.8/33.3/			177
Lusakert-1, layer CI	24.0	36.7	61.0/43.0/	high	52.0	1747
Yerevan-1, layer 2	>6.0	low		8.2	27.0	2877
Yerevan-1, layer 3	av. 6.0	av. >20.0	41.5/22.5/	14.2	34.6	2932
Yerevan-1, layer 4				12.5	28.2	1415
Yerevan-1, layers 5, Z, 6, 7	8.2	6.0	30.0/16.6/	6.7	33.0	4751

Note: av. means average for two or more layers.

features defined by Skinner (1965), excluding the low percentage of Levallois products that they believed was underestimated by previous researchers. Dibble and Holdaway (1993) concluded that the Zagros Mousterian is characterized by a knapping technology combining laminar (though real blades are rare) and Levallois recurrent flaking from uni- and bidirectional prepared cores (though radial flaking is also represented). They defined the typical Zagros Mousterian tool set dominated by simple and double side-scrapers and convergent pieces (defined as convergent scrapers or Mousterian points by various scholars), a low percentage of transverse and angled (*déjeté*) scrapers, tools worked with stepped (Quina) retouch, and the presence of truncated-faceted pieces. They also argued that the model of tool reduction through resharpening (Dibble, 1984) explains the most striking typological peculiarity of the Zagros Mousterian, such as the predominance of single and double scrapers and convergent pieces.

The importance of Dibble and Holdaway's (1993) study resides in the identification, using principal component analysis, of a clear dichotomy in the Zagros Mousterian assemblages: Bisitun and Warwasi in one group and Houmian, Shanidar D, Kunji, and Hazar Merd in the other (Dibble & Holdaway, 1993: tab. 2.11:B). They suggested that this reflects a varying intensity of tool reduction, separating the assemblages where the ILty index is low—indicating that more Levallois blanks were transformed (through resharpening) into scrapers and points—from the assemblages where the ILty is high—indicating that the reduction of tools was not intense and more Levallois blanks were left unworked.

These two groups are also distinguished by the blade index (Ilam), which is much higher in the Bisitun-Warwasi group (Table 1). Furthermore, most of the Zagros Mousterian assemblages in the Zagros show a lack of truncated-faceted pieces. They were not identified at Shanidar, Hazar Merd, and Houmian (Dibble & Holdaway, 1993: 79), and in most MP assemblages studied in the region in more recent times (Kamrani et al., 2022: tab. 9). A large number of truncated-faceted pieces was reported from three sites only: 115 at Bisitun (Dibble, 1984), twenty-three at Warwasi (Dibble & Holdaway, 1993), and twenty-five at Kunji (Baumler & Speth, 1993).

At the end of 1990s, Lindly (2005) presented an attribute analysis of some MP assemblages in the Zagros. He concluded

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that the Zagros Mousterian assemblages are specific (based on comparison between MP assemblages in the Zagros and the Levant) in several aspects: 1) tools are heavily resharpened, dominated by side-scrapers and points, and a statistical test confirmed Dibble's (1984, 1995) resharpening trajectory (through single, double, convergent, and *déjeté* scrapers); 2) larger flakes and tools that were transformed into cores are scarce, and the cores are small and exhausted, in the form of truncated-faceted or centripetal cores produced at the end of the reduction sequence; 3) the density of lithic artefacts is low, intimating that the length of occupation these artefacts document was relatively short.

Lindly (2005: 95) proposed that the Zagros Mousterian sites, which range in elevation from 740 to over 2000 m asl, represent camps occupied during the summer and thus present only one aspect of a larger settlement subsistence strategy of the Neanderthals in the region. However, in 2005, chronological and palaeoenvironmental data were virtually non-existent for the MP of the Zagros, and subsistence patterns of MP hominins in this region were unknown.

Current research on the Zagros Mousterian in the Zagros

In the 1990s and early 2000s, a major change in the methodology of lithic analysis in European prehistoric archaeology resulted in the shift from 'morphological typology', including the method of Bordes (1961b), to the concept of *chaîne opératoire* invented by Leroi-Gourhan (1964) but not applied in Palaeolithic archaeology until the 1990s (Bar-Yosef & Van Peer, 2009). This methodological shift greatly affected the definition of the Zagros Mousterian.

Since the 2000s, fieldwork in Iran has led to discoveries of MP assemblages in new cave sites in the Zagros, including the caves of Do-Ashkaft, Mar Tarik, Gilvaran, Kaldar, Ghamari, and Qaleh Kurd (Biglari & Heydari 2001; Jaubert et al., 2005, 2009, 2010; Bazgir et al., 2017; Reynolds et al., 2022; Kamrani et al., 2022) and the Bawa Yawan rockshelter (Heydari-Guran et al., 2021; Heydari et al., 2024) (Figure 1). Researchers concluded that most belong to the Zagros Mousterian. A novel research focus in this region is related to the discovery of MP sites (Qaleh Bozi 2 and Qaleh Bozi 3) with bifacial leaf points and a virtual lack of Levallois elements in the Iranian Central Plateau (Biglari et al., 2009; Jaubert et al., 2010). The issue of possible interaction in the Zagros between the Zagros Mousterian Neanderthals and other, culturally different groups of MP hominins that produced bifacial leaf points deserves attention.

The Mar Tarik cave (Jaubert et al., 2009) is of great interest for our topic. Using a new definition of Levallois technology developed by Boëda (1994, 1995) following the *chaîne opératoire* approach, Jaubert and colleagues concluded that Mar Tarik contained a Zagros Mousterian assemblage (360 pieces in total), dominated by Levallois recurrent flaking, including blades and side flakes (*débordants*) that are compatible with Levallois recurrent technology, with some use of volumetric flaking. The number of identified blades (twenty-seven pieces) is low (Ilam = 8.6) in comparison to other Zagros Mousterian sites, while the assemblage's typological indices are within the range typical for the Zagros Mousterian (Table 1). The 158 tools are dominated by single and double side-scrapers, and convergent tools that include Mousterian points, convergent and *déjeté* scrapers, and one limace. One truncated-faceted piece was also identified.

A technological analysis by Beshkani (2018) following the Levallois concept of Boëda (1994, 1995) indicates the predominance of Levallois technology in previously studied Zagros Mousterian assemblages,

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Figure 1. *Relief map of the Caucasus and Zagros mountains showing location of the MP sites discussed in the text.*

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including Bisitun, Shanidar D, and Warwasi. The Levallois technology is combined with discoid, volumetric, and Kombewa flaking in Warwasi, volumetric flaking in Bisitun, and Kombewa flaking at Shanidar D. This new understanding of the Levallois technology does not correspond at all to the definitions of Levallois technology and Levallois products that were used by researchers to define the Zagros Mousterian in the twentieth century.

The subsistence of the Zagros Mousterian Neanderthals received more attention. In particular, the study of the distribution of hunted species from MP sites in the Zagros (Yousefi et al., 2020) indicates that the mammals most frequently hunted by the Zagros Mousterian Neanderthals were wild goat (*Capra aegagrus*) and wild sheep (*Ovis gmelini* and *O. vignei*), and less frequently Persian gazelle (*Gazella subgutturosa*).

As of 2024, chronometric dates for the Zagros Mousterian in the Zagros are available from new excavations for the upper levels of layer D at Shanidar, indicating a late MP age between 55 and 45 kya (Pomeroy et al., 2017, 2020). An optically stimulated luminescence (OSL) date of 75–73 kya, and microfauna and palaeosols indicate that the lower part of layer D at Shanidar correlates to the late MIS 5 (Marine Isotope Stage 5) (Reynolds et al., 2022). A thorium-uranium date of 148±35 kya obtained for the MP layer 2a at the Houmian rockshelter (Bewley, 1984) indicates the MIS 5e age.

The radiocarbon and thermoluminescence (TL) results from Kaldar cave indicate that the Zagros Mousterian assemblage from layer 5 has a TL age of 63±6 kya, whereas the overlying layer 4 yielded radiocarbon dates from 54–46 to 44–42 ka cal BP (Bazgir et al., 2017). The MP layers at the Bawa Yawan rockshelter were dated to 43.6–41.5 ka cal BP and 40.3–39.4 ka cal BP (Heydari-Guran et al., 2021). However, OSL dates indicate that the ^{14}C dates underestimate the age of MP occupation, which falls in the 58–80 kya time frame (Heydari et al., 2024).

Summarizing the current state of research in the Zagros, Reynolds et al. (2022) conclude that the Zagros Mousterian represents a distinct MP techno-complex that spread in Iraq and Iran along the Zagros mountain range. Its chronology is still problematic, but available chronometric ages suggest that this lithic industry was present in the region from the beginning of the Last Interglacial (MIS 5e, about 130–120 kya) to about 40 kya.

The Zagros Mousterian in the Lesser Caucasus and Armenian Highlands

In the southern Caucasus, a group of MP sites is known, located mostly in the eastern part of the Lesser Caucasus in Azerbaijan, between the river Kura in the north and the river Araks in the south, and in the Armenian volcanic highlands in Armenia. In the 1970s–1990s, using Bordes' (1961b) method, researchers noted the similarity between the region's MP assemblages and the Zagros Mousterian in the Zagros (Jafarov, 1983, 1999; Liubin, 1984; Beliaeva & Lioubine, 1998), while none of these authors applied the term 'Zagros Mousterian' to the assemblages. Doronichev and Golovanova (2003) applied for the first time the definition 'Zagros Mousterian' to the MP assemblages in the Lesser Caucasus and Armenian highlands.

More than ten sites with Zagros Mousterian assemblages are known in the regions (Figure 1). Half were excavated in the 1960s–1980s (Yeritsyan, 1970, 1972, 1975; Jafarov, 1983, 1999; Liubin, 1984, 1989; Huseynov, 2010) (see Figures 2 and 3; Supplementary Material text and Figures S1–S6), with more recent excavations in some of these sites being published since (Fernández-Jalvo et al., 2010; Jafarov et al., 2010; Asryan et al., 2014; Gasparyan et al., 2014; Frahm et al., 2016a, 2016b; Gasparyan & Glauberman, 2022; Zeynalov et al., 2023).

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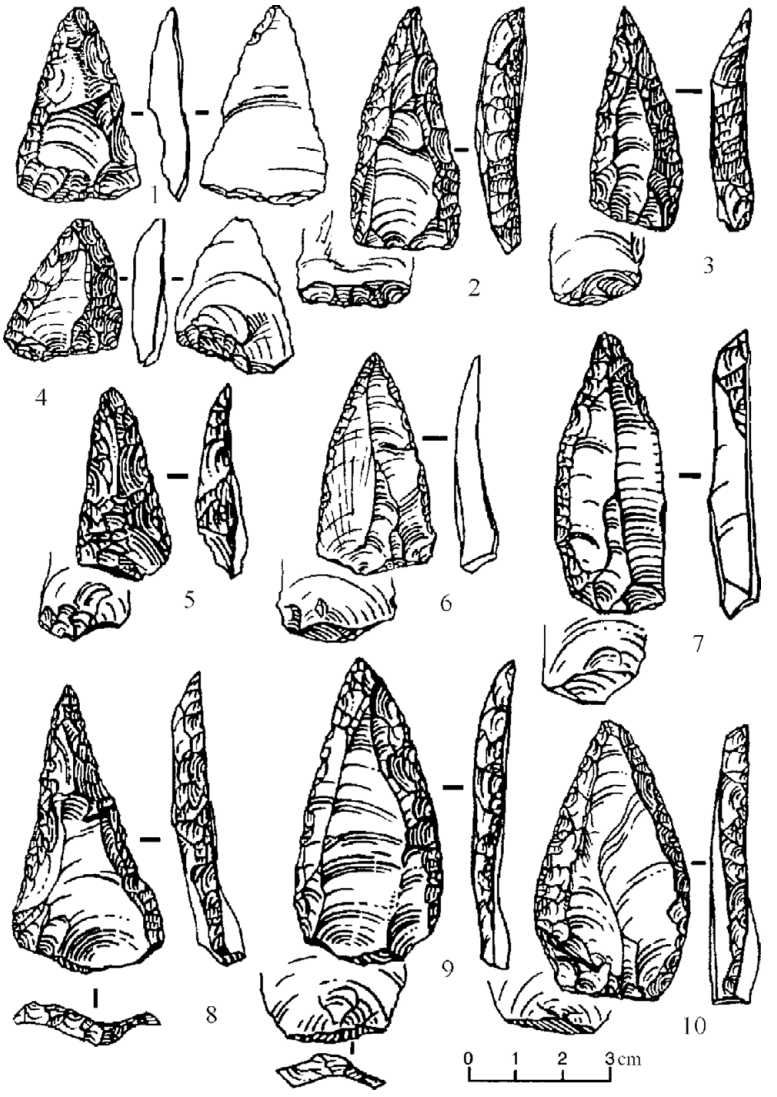

Figure 2. *Typical Zagros Mousterian tools from Taglar cave. 1–3) points with truncated-faceted bases; 4) convergent scraper with a truncated-faceted base; 5, 7) Mousterian points with thinned bases; 6, 8) retouched Levallois points; 9, 10) Mousterian points.*

Among the recently discovered MP sites in the Armenian highlands, a small Zagros Mousterian assemblage of eighty-four artefacts was found on the surface at the Angeghakot-1 rockshelter in Armenia (Liagre et al., 2006). The assemblage includes twenty-one points, ten of which are 'Yerevan points' with a truncated-faceted base (Gasparyan et al., 2014) typical to the Zagros Mousterian in the Lesser Caucasus and Armenian highlands.

The open-air site of Barozh-12 yielded a total of 12,549 obsidian artefacts (Glauberman et al., 2015). The assemblage shows a predominance of the Levallois recurrent technique. Tools include retouched Levallois and Mousterian points, and convergent scrapers (Gasparyan & Glauberman, 2022: fig. 15.3: B), including one point with a truncated-faceted base (Glauberman et al., 2015: tab. VIII-3; 2020).

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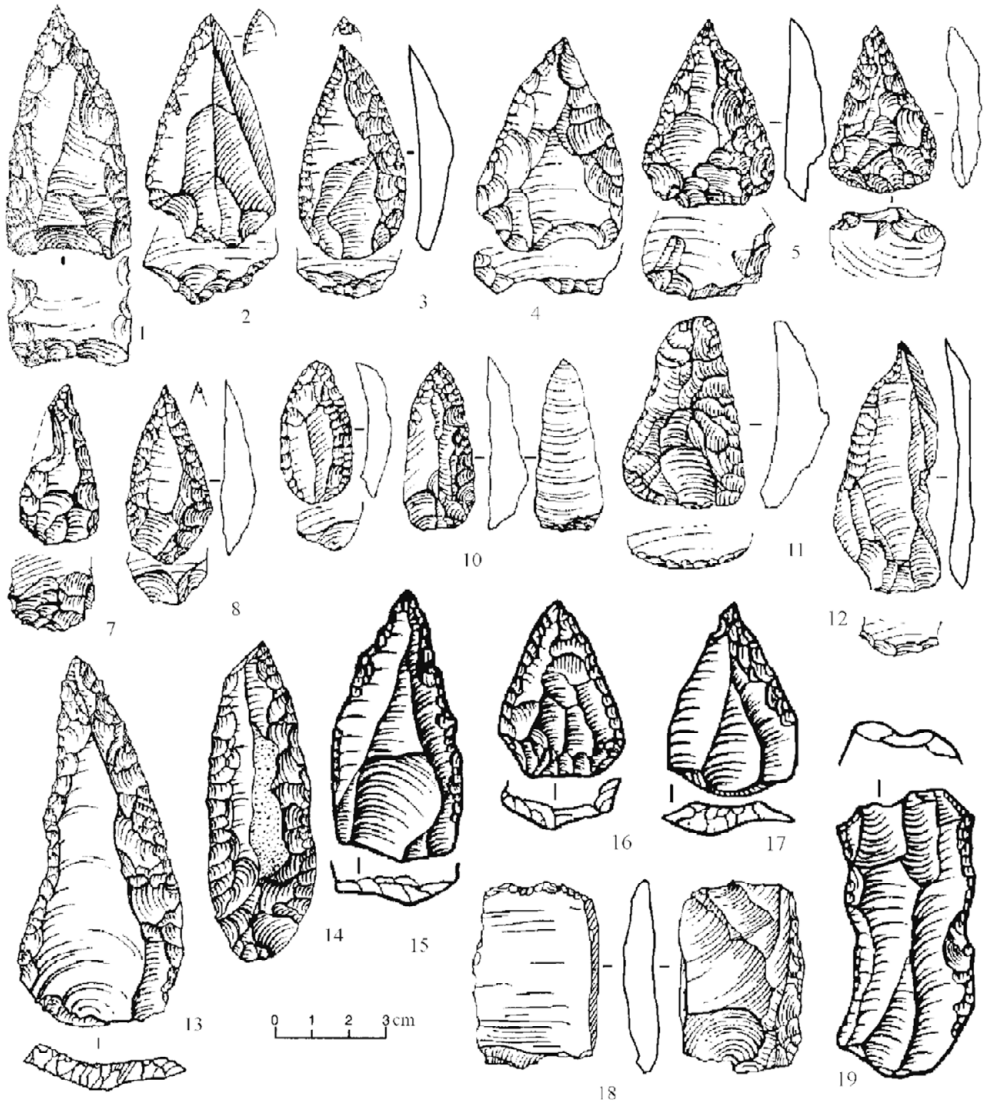

Figure 3. *Typical Zagros Mousterian tools from the caves of Yerevan-1 (1–13, 18) and layer CI at Lusakert-1 (14–17, 19). 1–10, 15, 16) points with truncated-faceted bases; 13) elongated Mousterian point; 14) elongated point in the form of a willow leaf with a broken tip; 17) retouched Levallois point; 11, 12, 18, 19) truncated-faceted scrapers.*

The open-air site of Bagratashen-1 yielded a MP assemblage comprising 500 lithic artefacts. It includes cores with Levallois recurrent and laminar flaking, Levallois, retouched Levallois and elongated Mousterian points (Gasparyan & Glauberman, 2022: fig. 15.4: B), side-scrapers, and eleven truncated-faceted pieces (Egeland et al., 2016).

The open-air site of Kalavan-2 yielded a total of 2661 MP lithic artefacts (Supplementary Material Table S1) from more than ten layers (Ghukasyan et al., 2011) or units (Malinsky-Buller et al., 2021). In the overall assemblage, the predominance of recurrent Levallois and laminar flaking, the combination of Levallois

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and blade production, a high frequency of convergent pieces (retouched points and convergent side-scrapers), and the presence of truncated-faceted pieces are characteristic of the Zagros Mousterian.

The MP assemblages from the caves of Taglar and Azykh (Azokh 1) in the Lesser Caucasus (Azerbaijan) and the caves of Yerevan-1 and Lusakert-1 in the Armenian highlands (Armenia) provide the most representative data about the Zagros Mousterian in these regions (Supplementary Material text; Table S3; Figure S7). This allows us to define the southern Caucasian variant of the Zagros Mousterian, characterized by the following features:

(1) A combination of laminar (blade) and Levallois recurrent flaking from unipolar and bipolar cores (radial flaking is represented on exhausted cores), and a high faceting index. As opposed to the Zagros Mousterian in the Zagros, the Levallois index is higher than the blade index in the southern Caucasian variant (Table 3).
(2) The tool set is dominated by single and double side-scrapers and convergent pieces (defined as convergent scrapers or points by various scholars); elongated Mousterian points made on blades are characteristic (Figures 2 and 3; Supplementary Material Figures S1, S3–S6). The percentage of *déjeté* scrapers is higher than in the Zagros Mousterian in the Zagros.
(3) Truncated-faceted pieces are more diverse and include tool types that are rare in the Zagros Mousterian in the Zagros, such as Mousterian points with a truncated-faceted base and scrapers with the dorsal surface truncated-faceted from two or more sides (Figures 2 and 3; Supplementary Material Figures S2–S4).

Golovanova and Doronichev (2003, 2005) posited that the long MP sequences from the caves of Yerevan-1, Lusakert-1, and Taglar provide a general succession (called the 'Yerevan–Taglar tradition') of cultural development of the southern Caucasian variant of the Zagros Mousterian from late MIS 5 to MIS 3. They also assumed that the first manifestations of the Zagros Mousterian in the Caucasus and Armenian highlands may have the earlier age.

Layer III at Azykh (Azokh-1) cave has yielded the oldest dated assemblage representing the Zagros Mousterian in the region (Supplementary Material). The fauna found in Layer III is similar to the fauna from the Binagady locality in Azerbaijan dated to the Last Interglacial (Jafarov, 1999), about 130–120 kya. Electron spin resonance (ESR) dates obtained for units II–IV at Azokh-1 (Fernández-Jalvo et al., 2010; Asryan et al., 2014) indicate an age within MIS 5–MIS 6 of the MP assemblage recovered in old excavations of Layer III (~ Unit II) and a Final Acheulian age (late MIS 7) of a few handaxes found in the lower part of Layer III (~ Unit III).

Data about long-distance obsidian transport indicate how far MP groups ranged and suggest potential interactions among various groups in the Caucasus and the Armenian highlands (Figure 4). Long-distance mobility patterns of MP hominins indicated by obsidian artefact sourcing suggest disconnection between MP populations in the northern and southern Caucasus, whose contacts were restrained by the Greater Caucasus mountain range, and limited contacts between the MP populations of the south-western Caucasus and Armenian highlands (Gasparyan & Glauberman, 2022: 289). Furthermore, obsidian artefact sourcing (Doronicheva et al., 2023) indicates limited interconnectivity between different MP populations in the north-western Caucasus (Eastern Micoquian) and north-central Caucasus (Zagros Mousterian).

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Table 3. *Comparison of technological indices (after Bordes, 1961b) defined for the main Zagros Mousterian assemblages in the Lesser Caucasus and Armenian highlands, the Zagros, and the northern Caucasus. For definition of the indices, see Debénath & Dibble (1994).*

Lesser Caucasus and Armenian highlands				Zagros				Northern Caucasus			
Assemblage (Age)	**Ilam**	**IL**	**IF /IFs/**	**Assemblage (Age)**	**Ilam**	**IL**	**IF /IFs/**	**Assemblage (Age)**	**Ilam**	**IL**	**IF /IFs/**
Taglar, layer 2	36.0	51.0	69.9/27.5/	Bisitun	55.1 (35.0)	55.8 (4.8)	64.7 (53.0)	Tinit–1, hors. 1–4 (av. ~ 43 ka, AMS)	21.0		17.0 /8.7/
Taglar, layer 3	33.1	51.3	73.1 /29.7/	Warwasi, unit C	38.0	7.5	45.9 /30.8/				
Taglar, layer 4a	43.7	53.1	73.6 /34.4/	Warwasi, unit B	45.3	7.4	53.8 /39.6/				
Taglar, layer 4b	39.0	52.1	62.8 /31.4/	Warwasi, unit A	43.2	13.1	50.2 /40.6/				
Taglar, layer 5	25.3	av. 38.4	57.5 /22.7/	Kunji	20.8	10.1 (4.5)	48.3				
Taglar, layer 6	30.7		60.8 /33.3/	Houmian, layer 2a (early MIS 3– MIS 4)	22.9	2.3	23.7	Tinit–1, hors. 5–9 (av. ~ 51 ka, AMS)	17.0		15.0 /11.2/
Lusakert-1, layer CI or unit 3 (~ 46 ka; IRSL)	24.0	36.7	61.0 /43.0/	Hazar Merd	20.3	7.0	47.1				
Yerevan-1, layers 3 & 4	av. 6.0	av. >20.0	41.5 /22.5/	Qaleh Kurd, phase 1	15.8	8.2	33.9 /33.9/	Saradj-Chuko, layer 6A (60–50 ka; OSL)	5.2	low	45.5 /38.8/
Yerevan-1, 5, Z, 6, 7	8.2	6.0	30.0 /16.6/	Qaleh Kurd, phase 2	12.6	7.4	30.4 /29.2/	Saradj-Chuko, layer 6B (90–70 ka; OSL)	10.7	12.0	42.7 /37.0/
				Qaleh Kurd, phase 3	12.3	10.5	28.6 /27.1/				

Notes: Indices for Warwasi after Dibble & Holdaway (1993, tab. 2.2); indices for Houmian, Kunji, Hazar Merd, and Bisitun are recomputed by Dibble & Holdaway (1993, tab. 2.9) on the basis of published type counts (after Skinner, 1965; Akazawa, 1975; Bewley, 1984), but some differ markedly from published indices (in parentheses). Indices for Qaleh Kurd were recomputed by the authors on the basis of published type counts (after Kamrani et al., 2022). Indices for Yerevan-1, Lusakert-1, and Taglar after Yeritsyan (1970, 1975) and Jafarov (1983, 1999). Indices for Saradj-Chuko and Tinit-1 after Anoykin et al. (2013) and Doronicheva et al. (2020).

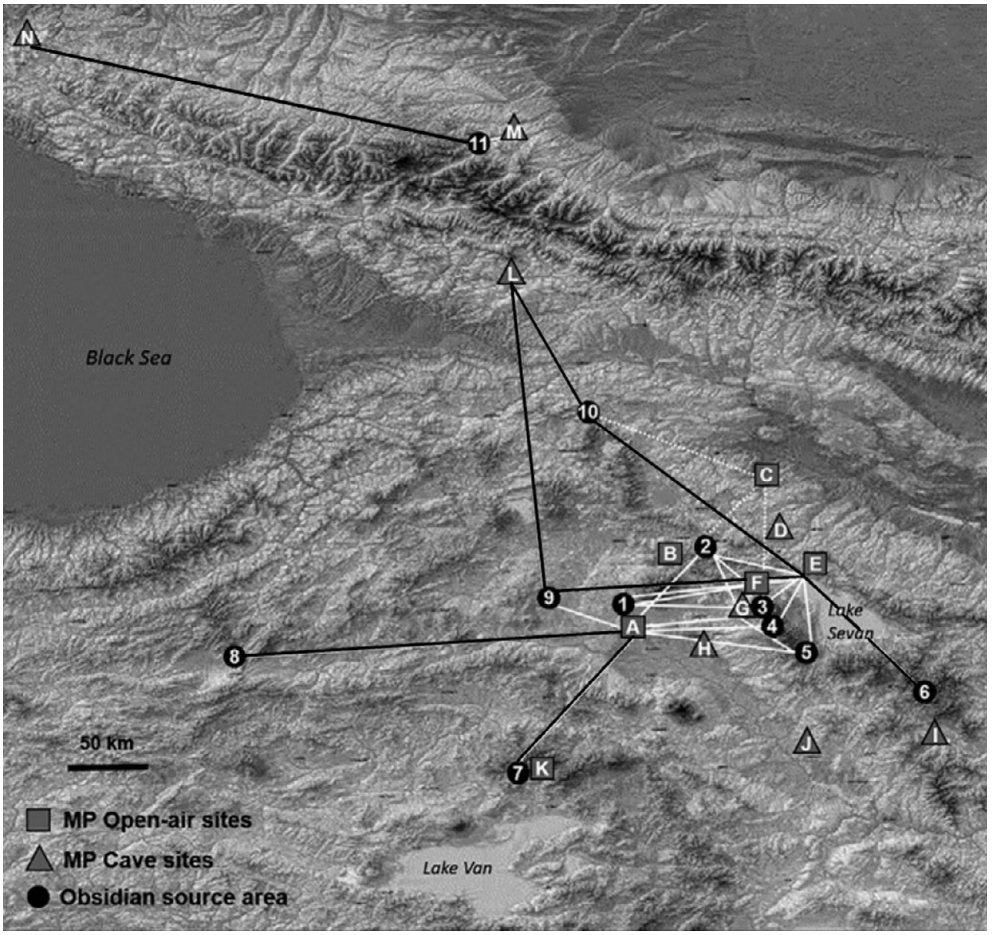

Figure 4. *Relief map of the Caucasus showing locations of MP sites, obsidian sources, and the movement of obsidian artefacts. MP sites: A) Barozh-12; B) Ria-Taza-1 and Aparan Depression sites; C) Bagratashen-1; D) Hovk-1; E) Kalavan-2; F) Alapars-1; G) Lusakert-1; H) Yerevan-1; I) Angeghakot-1; J) Gazma; K) Gurgurbaba Tepesi; L) Ortvale Klde; M) Saradj-Chuko; N) Mezmaiskaya. Obsidian source areas: 1) Arteni; 2) Tsaghkunyats; 3) Gutansar; 4) Hatis; 5) Gegham; 6) Syunik; 7) Meydan Dağ; 8) Pasinler; 9) Kars (Digor); 10) Chikiani; 11) Zayukovo (Baksan). Solid lines = XRF data; dotted lines = estimates; white solid lines = movement of obsidian indicating regular raw material procurement; black solid lines = obsidian movement indicating contacts. Modified from Gasparyan & Glauberman (2022, fig 15.5B).*

The Zagros Mousterian in the Northern Caucasus

Weasel Cave in the North Ossetia-Alania Republic (Russia) (Figure 1) was until recently the only stratified MP site known in the Terek river basin in the northern Caucasus (Hidjrati et al., 2010). In the cave, the upper MP layers 5–11 are dated to MIS 3. Layers 12 and 13 are tentatively dated to 50–90 kya (MIS 4–MIS 5c; Faulks et al., 2011); MP layer 14 may be also dated to MIS 5, based on a similar pollen spectrum. Golovanova (2015) noted the similarity of the MP assemblages from layers 12–14 (Supplementary Material text and Figure S8) with the Zagros Mousterian in the Lesser Caucasus and Armenian highlands.

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The recently discovered Saradj-Chuko cave is a benchmark Zagros Mousterian site in the northern Caucasus (Doronicheva et al., 2019, 2020, 2023, 2024), with three MP layers (3, 6A, and 6B) identified (Figure 5; Supplementary Material). OSL dating indicates that the lower MP layer 6B can be dated to the late MIS 5, between *c.* 90/80 and 70 kya. Layer 6A is dated to the early MIS 3, *c.* 60–50 kya, and layer 3 is dated to *c.* 45–40 kya.

Figure 6A and Table 3 show that the assemblages from Saradj-Chuko have low Levallois and blade indices and a high faceting index, features that are most similar to the Zagros Mousterian assemblage from Shanidar D and Qaleh Kurd in the Zagros and Yerevan-1 in the Armenian highlands. A high faceting index (IF) and strict faceting index (IFs) differentiates the assemblages from Saradj-Chuko from the Eastern Micoquian assemblages in the north-western Caucasus (Figure 6B). The predominance of side-scrapers and points, and the presence of truncated-faceted scrapers, which are typical of the Zagros

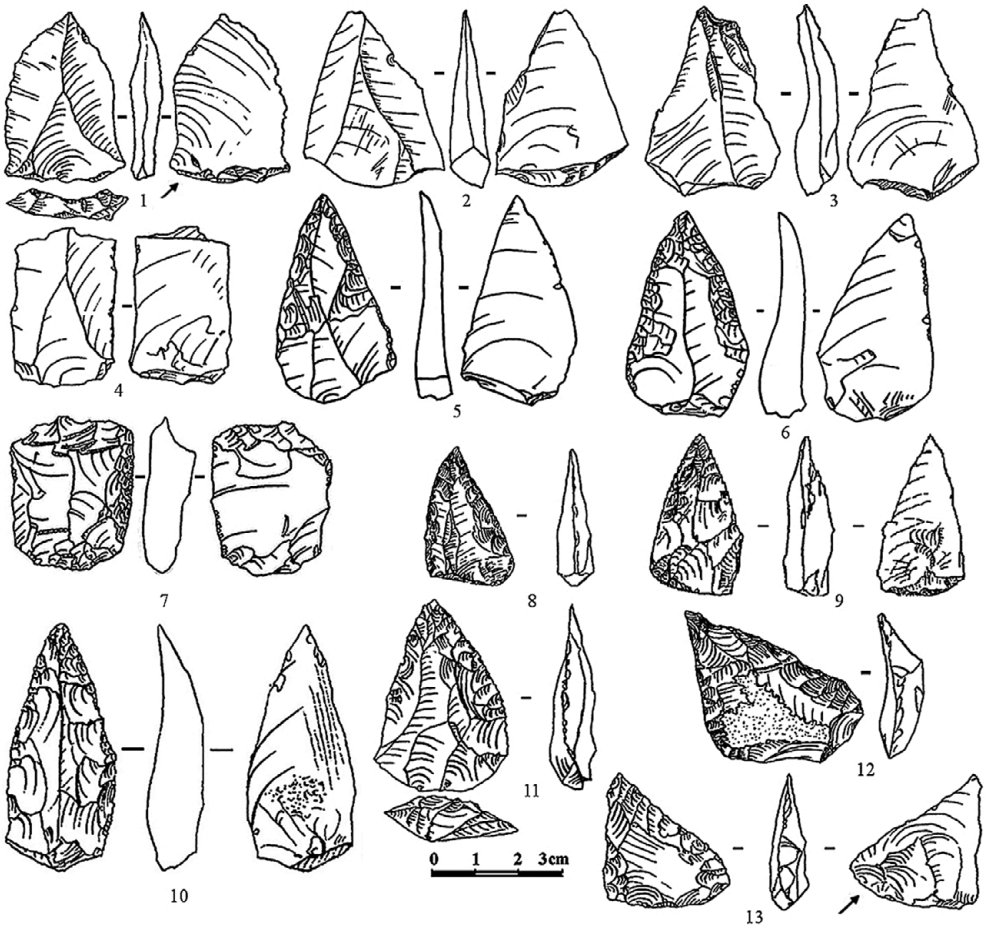

Figure 5. *Levallois blanks (1–4) and typical Zagros Mousterian tools (5–13) from Layer 6B at Saradj-Chiko cave. 1–3) Levallois triangular flakes (points); 4) Levallois blade; 5, 6, 10) elongated Mousterian points; 7) truncated-faceted scraper; 8, 9, 11) Mousterian points; 12, 13) angled (*déjeté*) scrapers.*

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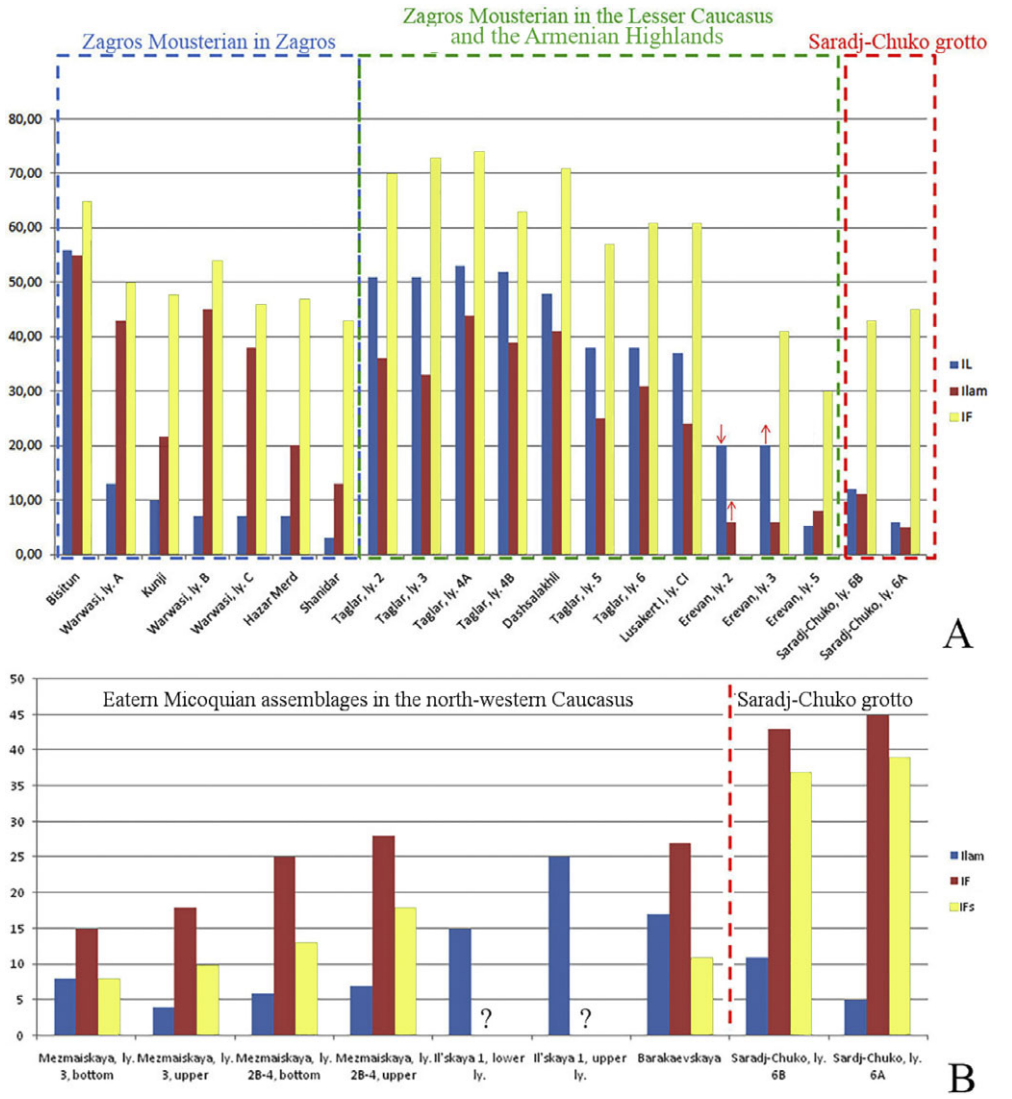

Figure 6. *A) Histograms showing the variability of the Levallois index (IL), blade index (Ilam), and faceting index (IF) in the Zagros Mousterian assemblages in the Zagros, Lesser Caucasus, and Armenian highlands in comparison to the Zagros Mousterian assemblages from layers 6B and 6A at Saradj-Chuko cave. B) Histograms showing variability of Ilam, IF, and strict faceting index (IFs) in the Eastern Micoquian assemblages in the north-western Caucasus in comparison to the Zagros Mousterian assemblages from layers 6B and 6A at Saradj-Chuko.*

Mousterian but absent in the Eastern Micoquian, also indicate the similarity between the MP assemblages from Saradj-Chuko and the Zagros Mousterian.

In the north-eastern Caucasus, the open-air site of Tinit-1 produced a stratified succession of eight or eleven MP horizons radiocarbon-dated from 43 to 51 ka cal BP (Anoykin et al., 2013). The assemblages show similarities with the assemblages from the Saradj-Chuko and Weasel caves, in the combination of laminar volumetric and

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Levallois recurrent flaking from prepared platforms and the tool set typical of the Zagros Mousterian (Table 3; Supplementary Material text and Figure S9).

Discussion and Conclusions

Common technological features and tool types discussed in this article differentiate the Zagros Mousterian from other MP industries in neighbouring regions. A techno-typological heterogeneity found among the Zagros Mousterian assemblages in the Zagros (Bewley, 1984; Dibble, 1984; Dibble & Holdaway, 1993) and Caucasus (Golovanova & Doronichev, 2003) suggests that this industry can be subdivided into chronological stages and geographical variants. Here, we propose to define three geographical variants of the Zagros Mousterian, namely in the Zagros, Lesser Caucasus and Armenian highlands, and the northern Caucasus.

Table 3 shows that in each of these regions there are notable technological differences between the earlier and later assemblages, indicating the advance of blade technology. In the Lesser Caucasus, Armenian highlands, and Zagros, the increase in the faceting indices also indicates the advance of platform preparation. Only in the Lesser Caucasus and Armenian highlands does the increase in the Levallois index indicate the advance in Levallois flaking.

Despite significant geographical differences in natural environments and elevation, studies of the subsistence, and specifically the lithic raw material strategies, suggest that the Zagros Mousterian Neanderthals targeted local raw material sources and established their habitation sites close to these sources and their workshop sites directly at the sources (Anoykin et al., 2013; Gasparyan et al., 2014; Frahm et al., 2016b; Glauberman et al., 2015, 2020; Gasparyan & Glauberman, 2022; Kamrani et al., 2022; Doronicheva et al., 2020, 2024).

In each of the three regions there are artefacts suggesting contacts between the Zagros Mousterian hominins and other culturally different hominins. In the Caucasus, these contacts are also indicated by the presence of obsidian from distant sources (Gasparyan & Glauberman, 2022; Doronicheva et al., 2023) (see Figure 4).

Currently, the oldest chronometric estimates (from *c.* 100 to 180 kya) in Azykh (Azokh-1) cave (Fernández-Jalvo et al., 2010) suggest that the Zagros Mousterian originated in the southern Lesser Caucasus during a time ranging from MIS 6 to early MIS 5. It evolved locally in the region (as indicated by the MP sequence of Taglar cave, presumed to date to MIS 3) and spread during MIS 5–MIS 3 to the Armenian highlands in the west, the Zagros mountains in the south, and the eastern North Caucasus in the north (Figure 7).

The archaeological evidence from the Caucasus suggests that the spread of the Zagros Mousterian within the region was restricted by juxtaposition with other culturally different groups of MP hominins who settled in the north-western (Golovanova, 2015; Doronicheva et al., 2023) and south-western Caucasus (Golovanova & Doronichev, 2003, 2005). Moreover, the Zagros Mousterian can be related with the spread of MP hominins from the Lesser Caucasus via the southern coast of the Caspian Sea to Central Asia and Altai (Ghasidian et al., 2023). Kolesnik (2023) also proposed affinity with the Zagros Mousterian for the Belokuzminovka-Shlyakh group of MP sites in the Russian plain.

Neanderthal fossils associated with the Zagros Mousterian in the Zagros, including the remains of ten Neanderthal individuals discovered at Shanidar cave (Solecki, 1963; Pomeroy et al., 2017, 2020), and the Neanderthal remains found in the Bisitun cave (Trinkaus & Biglari, 2006) and the

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Figure 7. *Relief map showing the distribution of the Zagros Mousterian in the Zagros, Lesser Caucasus, Armenian highlands, northern Caucasus, and the Eastern Micoquian in Eastern Europe and northern Caucasus. Squares indicate open-air sites and triangles indicate cave sites. Yellow = Eastern Micoquian sites in the northern Caucasus; red = Zagros Mousterian sites in the northern Caucasus; pink = Zagros Mousterian sites in the Lesser Caucasus and Armenian highlands; blue = Zagros Mousterian sites in the Zagros. Modified from Doronicheva et al. (2023: fig. 1).*

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Bawa Yawan rockshelter (Heydari-Guran et al., 2021), clearly indicate that Neanderthals were makers of this industry. In the Caucasus, Neanderthal fossils associated with the Zagros Mousterian have been reported from two caves: Azokh-1 (King et al., 2016) and Yerevan-1 (Yeritsyan, 1970).

The data summarized in this article allow us to conclude that a culturally specific Zagros Mousterian Neanderthal population, not related to the European Neanderthals (associated in the Caucasus with the Eastern Micoquian; see Supplementary Material), occupied the eastern part of the Caucasus mountains, from the river Terek in the north to the river Araks in the south, and the Zagros mountains south of the Caucasus. The evidence suggests contacts between the Zagros Mousterian Neanderthals and other culturally different Neanderthal populations.

Supplementary Material

The supplementary material for this article can be found at http://doi.org/10.1017/eaa.2025.11.

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Competing Interests

The authors declare that the manuscript has not been published before and is not under consideration for publication anywhere else. Its publication has been approved by all co-authors. Authors have no conflicts of financial or non-financial interests that are directly or indirectly related to the work submitted for publication.

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Le Moustérien du Zagros dans le Zagros, le Caucase et sur le haut-plateau arménien

La très grande variabilité technologique et typologique dans le Zagros des ensembles du Paléolithique moyen autrefois attribués au Moustérien du Zagros suggère que cette industrie ne représente pas une entité culturelle homogène. Les témoignages archéologiques provenant du Caucase et du haut-plateau arménien fournissent des données importantes pour comprendre la variabilité du Moustérien du Zagros. Les auteurs de cet article démontrent que les longues séquences stratigraphiques des grottes de Taglar dans le Petit Caucase et d'Erevan-1 sur le plateau arménien documentent un processus de développement d'une variante du Moustérien du Zagros ('tradition Erevan-Taglar') dans ces régions au cours du Paléolithique moyen finissant, au moins à partir de 60/55 ka et jusqu'à 40 ka. On date les manifestations les plus anciennes du Moustérien du Zagros dans le Zagros, le Petit Caucase et le haut-plateau arménien vers le début du MIS 5 ou avant. Les ensembles du Paléolithique moyen de la grotte de Saradj-Chuko, datant d'entre 90/80 et 40 ka, et de deux autres sites du Paléolithique moyen dans le bassin de la rivière Terek représentent la variante caucasienne septentrionale du Moustérien du Zagros, qui était présent dans la région entre le MIS 5 et le MIS 3. Les restes de Néandertaliens associés aux ensembles du Moustérien du Zagros dans le Zagros et le Caucase indiquent clairement que les hominiens liés à cette tradition culturelle étaient des Néandertaliens. Translation by Madeleine Hummler

Mots-clés: Caucase, haut-plateau arménien, Zagros Paléolithique moyen, Moustérien du Zagros, Néandertaliens

Das Zagros Moustérien im Zagros-Gebirge, in Kaukasien und im armenischen Hochland

Die sehr große technologische und typologische Variabilität unter den mittelpaläolithischen Befunden im Zagros-Gebirge, welche früher dem Zagros Moustérien zugeordnet wurden, lässt darauf schließen, dass diese Industrie keine homogene kulturelle Einheit ist. Die archäologischen Funde und Befunde aus dem Kaukasus und dem armenischen Hochland liefern wichtige Angaben über die Variabilität des Zagros Moustérien. Die Verfasser zeigen, dass die langen Schichtenfolgen in den Höhlen von Taglar im Kleinen Kaukasus und Jerewan-1 im armenischen Hochland eine Entwicklungslinie („Jerewan-Taglar Tradition") einer Variante des Zagros Moustérien im späten Mittelpaläolithikum (mindestens von 60/55 ka bis 40 ka) in diesen Gebieten darstellen. Die frühesten Erscheinungsformen des Zagros Moustérien im Zagros-Gebirge, im Kleinen Kaukasus und armenischen Hochland könnten auf die frühe MIS 5 Stufe oder früher zurückgehen. Die auf 90/80 ka bis 40 ka datierten mittelpaläolithischen Befunde in der Höhle von Saradj-Chuko und in zwei anderen mittelpaläolithischen Stätten im Becken des Flusses Terek gehören zu einer nordkaukasischen Variante des Zagros Moustérien, die in diesen Gegenden von MIS 5 bis MIS 3 existierte. Die Überreste von Neandertalern, welche in Zusammenhang mit den Befunden des Zagros Moustérien im Zagros-Gebirge und im Kaukasus gefunden wurden, weisen deutlich darauf hin, dass die mit dieser kulturellen Tradition verbundenen Homininen Neandertaler waren. Translation by Madeleine Hummler

Stichworte: Kaukasus, armenisches Hochland, Zagros, Mittelpaläolithikum, Zagros Moustérien, Neandertaler

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